50 years existence and active participation of EEMS (now EEMGS) in the scientific community

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Minireview

50 years existence and active participation of EEMS (now EEMGS) in the scientific community: A driver of European and international scientific collaborations for the protection of the environment and human health from genome stressors

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ABSTRACT

EEMS and its successor Society EEMGS have provided a dynamic and successful platform to stimulate research and exchanges among the different actors involved in the protection of the environment and of human health from exposure to genome stressors. It includes basic, translational and applied research projects. This was possible due to the enthusiasm, creativity and support of scientists convinced of the importance of these issues.

In the future young scientists will take over with new questions, new challenges, new technologies, new discoveries and new applications. A major challenge is the ethical questions emerging from the impressive potential of present genetic technologies capable of impacting the evolution of nature and humankind. The EEMGS, where academics, regulators and industries meet, should play a central role in these aspects, in particular in support of primary prevention and the establishment of internationally recognized guidelines. Collaboration with colleagues and other teams are of great importance to establish a stimulating open dialogue on scientific questions. However the key issues remain to do careful and rigorous research; to use logic and background knowledge; to define adequate experimental designs; to provide transparency in the protocols; to check repeatability of the results and to combine several statistical approaches in the quest to get to the truth.

Among the many challenges ahead, re-evaluation of some key fundamental questions is necessary, such as the interplay between genetics and epigenetics, the existence of specific germ cell mutagens or the identification of the mechanisms leading to mutagen induced diseases. Translational and applied research will further include the development of systemic biomonitoring protocols, if possible in a single biological sample, the redaction of internationally harmonized guidelines but also the organization of platforms between geneticists and physicians open to all actors in the field. The creation of an independent European center to assess risk from exposure to mutagens, in particular in the light of the problematic of global warming might be very helpful.

1. Goals of EEMGS

The EEMGS (European Environmental Mutagenesis and Genomics Society) champions the study of mutagens and substances of related biological activity in the human environment, particularly where there is concern for public health, by engaging in and sponsoring research and the study and dissemination of information relating to the foregoing. Regional Societies of EEMGS are active in many European countries. The larger ones are found in Germany, United Kingdom, France, Italy and The Netherlands. Some of the smaller Societies are those in the countries of Central Europe. EEMGS had the G for Genomics added to the original society name (EEMS) in 2017 to broaden the scope to include new genomics technologies.

EEMGS will have existed for 50 years in 2020 and it has been a scientific and social network for many distinguished and high-profile researchers. Its key activity has been the annual conferences arranged in different cities throughout Europe to balance east-west-north-south. The map in Fig. 1 demonstrates the geographical broadness achieved, where member societies have developed outstanding days of science and friendship in collaboration with pan-European scientific boards and

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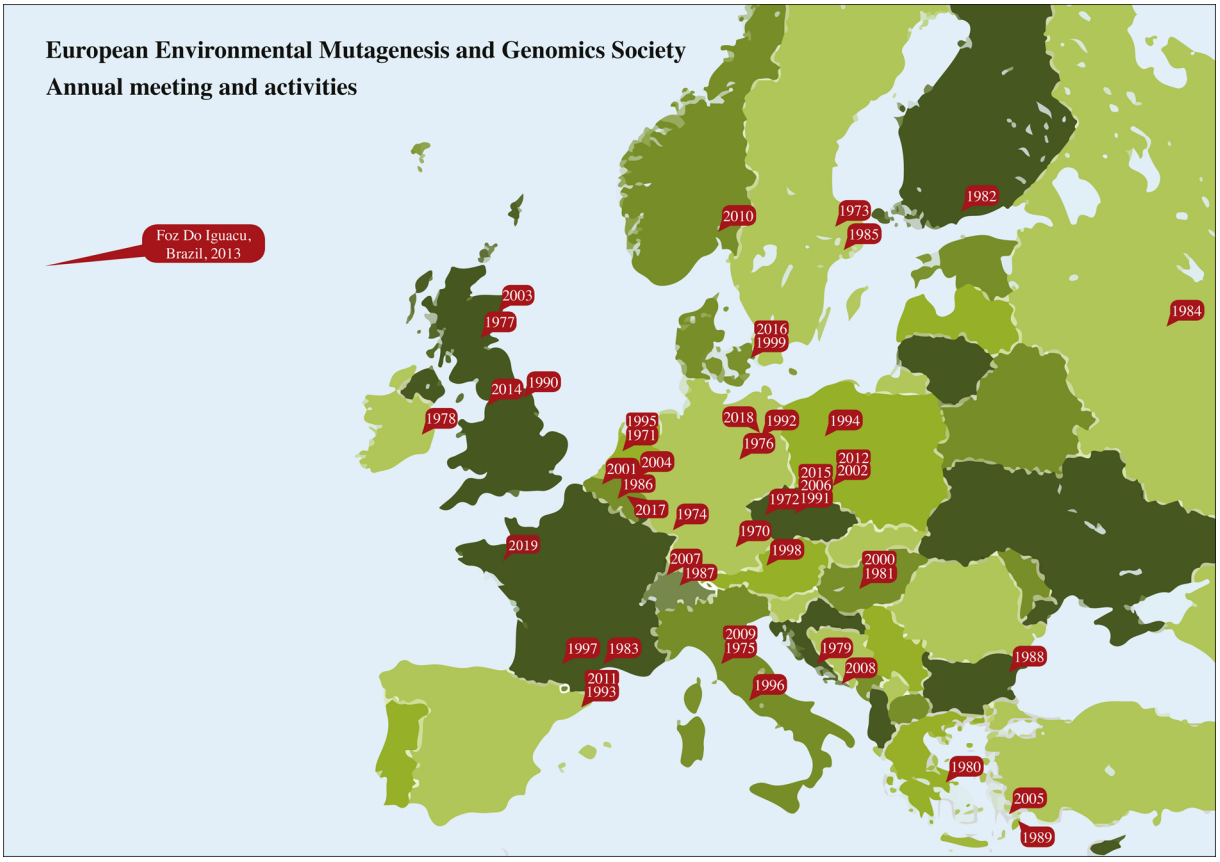

Fig. 1. Map of locations for annual meetings of EEMGS.

Box 1

The International Association of Environmental Mutagenesis and Genomics Societies (IAEMGS) is a global organization composed of 13 regional Environmental Mutagenesis and Genomics Societies around the world. To better reflect the interests and foci of the member societies, in the Fall of 2013 the IAEMGS changed its name from the International Association of Environmental Mutagen Societies. The IAEMGS sponsors and/or otherwise supports a variety of international conferences, most notably the quadrennial International Conference on Environmental Mutagens (ICEM). The IAEMGS also supports local EMGS meetings, as well as other relevant meetings such as the International Conference on Mechanisms of Antimutagenesis and Anticarcinogenesis (ICMAA), and the International Conference on Environmental Mutagens in Human Populations (ICEMHP), and the International Workshops on Genotoxicity Testing. The IAEMGS also provides support for Alexander Hollaender genetic toxicology training courses, which are regularly held worldwide. By promoting collaboration and communication among its member societies, the IAEMGS promotes, supports and fosters training and research in genetic toxicology and environmental mutagenesis. (IAEMGS website).

Members of IAEMGS:

Asociación Latinoamericana de Mutagénesis, Carcinogénesis y Teratogénesis Ambiental (ALAMCTA)
Brazilian Association of Mutagenesis and Environmental Genomics (MutaGen-Brasil)
Chinese Environmental Mutagen Society (CEMS)
European Environmental Mutagenesis and Genomics Society (EEMGS)
Environmental Mutagenesis and Genomics Society (EMGS)
Environmental Mutagen Society of India (EMS India)
Iranian Environmental Mutagen Society (IrEMS)
The Japanese Environmental Mutagen Society (JEMS)
Korean Environmental Mutagen Society (KEMS)
Molecular and Experimental Pathology Society of Australasia (MEPSA)
Pan-African Environmental Mutagen and Genomic Society (PAEMGS)
Philippines Environmental Mutagen Society (PEMS)
Thai Environmental Mutagen Society (TEMS)

If you are a member of a local society then you are also a member of the EEMGS. If you are not a member or there is no local society to become a member of then you can become an individual member of the EEMGS Registered members of the EEMGS will be given access to the members' only section of the EEMGS website and forum, where they can view newsletters, see/post Job Vacancies and CVs. Members can also view information on upcoming meetings and submit registration forms and abstracts for the EEMGS annual meeting. (EEMGS website).

Table 1
List of presidents in the European Society.

President	Period
Fritz H. Sobels – The Netherlands	1970–1973
Per Oftedal – Norway	1973–1975
Bryn Bridges – UK	1975–1977
H. Böehme – DDR	1977–1979
Nicola Loprieno – Italy	1979–1981
Udo H. Ehling – West Germany	1981–1983
Clas Ramel – Sweden	1983–1985
Paul H.M. Lohman – The Netherlands	1985–1987
Andrew E. Czeizel – Hungary	1987–1989
B.E. Matter – Switzerland	1989–1991
Ethel Moustacchi – France	1991–1993
Radim Šrám – Czechoslovakia	1993–1995
James M. Parry – UK	1995–1997
Herman Autrup – Denmark	1997–1999
Ilse-Dora Adler – Germany	1999–2001
Angelo Carere – Italy	2001–2003
Kristof Szyfter – Poland	2003–2005
Micheline Kirsch-Volders – Belgium	2005–2007
Eugenia Dogliotti – Italy	2007–2009
David Kirkland – UK	2009–2011
Günther Speit – Germany	2011–2013
Leon Mullenders – The Netherlands	2013–2015
Lisbeth E. Knudsen – Denmark	2015–2017
Helga Stopper – Germany	2017–2019
George Johnson – UK	2019-

the board of the EEMGS.

EEMGS organised meetings with programmes of interest to scientists with academic, regulatory and industry backgrounds as well as to other stakeholders. Presentations have highlighted the newest results in basic, translational and applied science, many at the highest scientific level. Sessions have focused on mechanisms (e.g. mitosis, meiosis, DNA repair, cell death, cancer), testing (including new technologies of, for example, omics), biomonitoring (e.g. occupational exposures and early-life exposures), regulation (aiming at updating test requirements) and application (e.g. presenting the newest classification systems related to genotoxicants as well as carcinogenic and reproductive toxicants). Keynote lectures have been given by many internationally renowned speakers along with oral presentations by participants selected from submitted abstracts. Each year the Frits Sobels Medal is awarded to an outstanding scientist and an early career scientist can also be nominated for the Early Career Award. Special support has been given to young scientists through travel awards and by the inclusion of sessions dedicated to short presentations and awards for poster presentations that provide feed-back to presenters.

These rewards for scientists still in the early stages of their careers have been welcomed by the students and postdocs and their teams and are seen as the first steps acknowledging excellence and paving the way for later rewards.

2. History of EEMS/EEMGS

The late Professor Frits H Sobels took the initiative, inspired by the US initiative in 1969 as described by David DeMarini [1], which led to the foundation in 1970 of the European Environmental Mutagen Society (EEMS) as an organization to promote both fundamental and applied research in the fields of environmental mutagenesis and genetic toxicology (Box 1).

The foundation of the Society was the result of discussions between a small group of geneticists and toxicologists who were seriously concerned about possible long-term adverse biological effects of chemicals in the human environment. The main goal of the Society was to study and evaluate potential genetic and carcinogenic hazards to humans from exposure to the increasing number and variety of chemicals in our environment.

Table 2
List of Scientific prize winners.*

Winners of the EEMS Award	Year
Fritz H. Sobels – The Netherlands (Environmental mutagenesis in retrospect) [2]	1986
PD Lawley – UK (carcinogenesis by alkylating agents)	1987
Udo H Ehling – Germany – Genetic risk assessment	1988
Claes Ramel – Sweden – The nature of spontaneous mutations	1989
Adajapalam T Natarajan – The Netherlands – Genomic instability	1990
Bryn A Bridges – UK – DNA repair	1991
Lars Ehrenberg – Sweden – Human health risk assessment and biological reactive intermediates: hemoglobin binding [3].	1992
Raymond Devoret – France – DNA repair	1993
Winners of the FH Sobels Award (formerly EEMS Award)	
H John Evans – UK – Mutation and mutagenesis in inherited and acquired human disease [4]	1995
Gregorio Olivieri – Italy – Effects and interaction of low dose irradiation	1997
Friedrich E Würgler – Germany [5]	1998
Ethel Moustacchi – France – Fanconi anaemia	1999
Radim J Sram – Czech Republic – Air pollution and genotoxicity	2000
Helmut Bartsch – Germany Hunting for electrophiles that harm human DNA [6]	2001
Marja Sorsa – Finland – Occupational expsore to genotoxicants	2002
Jim M Parry – UK – Aneuploidy	2003
Alain Sarasin – France – Xeroderma pigmentosum: from symptoms and genetics to gene-based skin therapy. [7]	2004
Silvio de Flora – Italy – Mechanisms of cancer chemopreventive agents [8]	2005
Herman Autrup – Denmark – DNA adducts from traffic generated air pollution	2006
Alan R Lehmann – UK – DNA repair	2007
Leon H Mullenders – The Netherlands – DNA repair	2008
Ilse-Dora Adler – Germany – Aneuploidy	2009
Ricardo Marcos – Spain – Cytogenetic analysis	2010
Micheline Kirsch-Volders – Belgium – In pursuit of the chromosome: Micronucleus assay *in vitro* and for human biomonitoring	2011
Peter Farmer – UK – Assessment of oxidatively damaged DNA	2012
David Phillips – UK – DNA adducts: detection, characterisation, biological consequences	2013
Hansruedi Glatt – Germany – Adducts and metabolic activities	2014
Eugenia Dogliotti – Italy – The response to DNA damage – repair pathways	2015
Margareta Törnqvist – Sweden – Human exposure to genotoxic agents: detection, quantification and risk estimation perspectives	2016
Bernd Epe – Germany – Oxidatively generated base modifications in DNA: Not only carcinogenic risk factor but also regulatory mark? [9]	2017
Andrew R. Collins – UK – The Comet assay	2018
Barbara Tudec – Poland – Understanding the DNA damage removal mechanisms	2019

* Titles of presentations are from best available sources including PUB MED searches around the year of presentation.

The society was set up as a friendly society with an executive board consisting of the President elected as Vice President (President-elect) for 2 years followed by a presidential period for 2 years and finalising with a Past President period of 2 years. The Office of the Scottish Charity Regulator (OSCR) in 2016 gave consent to the proposed change of name to European Environmental Mutagenesis and Genomics Society.

In Table 1 all Presidents since the Society's initiation are listed and Tables 2 and 3 provide the names of winners of awards given by the Society.

Several awards are given by EEMS/EEMGS. The Frits Sobels Award recognizes outstanding contributions to the field of environmental mutagenesis; it may recognise either a lifetime accomplishment or an episodically pace-making contribution to the field of environmental mutagenesis. It is presented during the annual EEMGS meeting. The prize consists of an inscribed token, free registration as well as coverage of travel and accommodation to the EEMGS meeting at which the awardee presents a lecture. During the annual meeting, one or more Early Career Award(s) are also presented. The awardee also presents a

Table 3
List of Young scientist award winners*.

Young Scientist Award Winners	Year
Ulf Rannug SE – Environmental mutagens and Ames test, D Siebert – GDR – Environmental mutagens and yeast	1981
Hannu J Norppa – Finland – Cytogenetics	1983
Jan CM van der Hoeven – The Netherlands – Testing in HGPRT and SCE assays	1985
Ileana Quinto – Italy – Mutagenicity of pesticides	1986
Dennis Hellegren – Sweden – Sister chromatid exchange	1989
Manuel Ruiz-Rubio – Spain – Alkylating agents and Ames test	1990
Harry Vrieling – The Netherlands – DNA repair	1991
Helen Tinwell – UK – Genetic toxicology, Anne Stary – France – recombination	1993
Ari Hirvonen – Finland – Genetic polymorhisms and occupational health exposures	1994
Alberto Izzotti – Italy – DNA adducts	1995
Helga Stopper – Germany – Genotoxicity and hormones	1996
Jordi Surrallés – Spain – Links between chromatin structure, DNA repair and chromosome fragility	1998
Andreas Hartmann – Germany – The Comet assay	1999
Dominique Renault – France – Kinetics of DNA damage, Thomas E. Schmid – Germany – Sperm aneuplouidy	2000
Dorota Butkiewicz – Poland – Genetic polymorphisms, Daniela Cimini – Italy – Mechanisms of aneuploidy	2001
Andreas Rothfuss – Germany – Oxidative stress	2002
Marcus Cooke UK – DNA damage and repair, Gareth Jenkins – UK – Unfolding large-scale genome maps	2003
Mariarosaria D'Errico – Italy – DNA repair	2004
Tomas Helleday – UK/Sweden – PARP2 as target for cancer therapy	2005
Volker Arlt – UK – DNA damage and DNA adduct detection	2006
Karen Brown – UK – Tamoxiphen and DNA adducts	2007
Cecilia Lundin – Sweden – DNA repair pathways as targets for cancer therapy	2008
Shareen Doak – UK – Genotoxic thresholds, DNA repair, and susceptibility in human populations	2009
Eva Petermann – UK – Pathways of mammalian replication fork restart	2010
Ilse Decordier – Belgium – Micronucleus assay and labeling of centromeres with FISH technique.	2011
George E Johnson – UK – Derivation of point of departure (PoD) estimates in genetic toxicology studies and their potential applications in risk assessment.	2014
Vanessa Valdiglesias – Coruna, Spain: Characterisation of harmful effects of potentially toxic agents by using cellular and molecular biomarkers	2015
Sabine Langie, Belgium: Environmental and epigenetic programming of complex diseases	2016
Rhiannon David – UK – DNA damage and disease pathways	2018
Julia Bornhorst – Germany – Establishing new testing strategies for C. elegans	2019

* Titles of presentations are from best available sources including PUB MED searches around the year of presentation.

lecture at the EEMGS meeting.

Also a limited number of travel grants are available to assist early career EEMGS members to attend the annual meetings.

3. EEMS and EEMGS: past strengths and challenges

The EEMS was timely established to promote scientific promotion of a field in full development due to the fast progresses in the deciphering of genetics, the availability of specific molecular approaches and the challenging environmental problems associated with pollution by synthetic chemicals. Growing attention to environmental challenges were seen in the Seveso accident with major exposures to dioxins and growing concern in rise in cancer incidences, reproductive failures and effects on wildlife.

The presence of the three major actors involved in the assessment of environmental mutagenicity - academics, industries and regulators - implied open dialogues and established scientific impacts on guidelines not only in the EU but also in collaboration with societies in other parts of the world, and promoted OECD and other test guidelines.

The establishment of a scientific platform with open discussions and friendly competition implied many useful collaborations and network formation related to urgent issues of e.g. genotoxic effects resulting from accidental releases and spillage and from more insidious exposures.

In earlier years alternating meetings between East and West European countries promoted scientific exchanges and collaborations and many young scientists used these meetings to establish exchange visits with colleagues in their field.

In many instances the meetings have been held at universities to reduce the cost of participation and to demonstrate the critical importance to the field of environmental health of fundamental research and teaching taking place in universities.

There have been a number of EU-supported projects validating methodologies, such as cytogenetics, DNA adducts and the comet assay. Results of the interlaboratory trials conducted have been a frequent and valuable feature of EEMGS conferences, often in special sessions.

Publishing results is critical for outreach and the support by two important scientific editors/journals: Mutation Research and Mutagenesis have been instrumental in promoting the scientific dissemination of advances in the field of environmental mutagenesis.

Finally, financial support from industrial associations has promoted dialogue between scientists from academic regulatory and industry bodies. For example, the European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC) has supported specific workshops devoted to the translational aspects of environmental mutagenesis from the bench to practical issues, previously in 2015 and now again in 2019.

The EEMGS depends on individual initiatives as no major economic source supports its infrastructure and it relies on individual interest and institutional back-up. The local organisation of each meeting is a major effort that has to draw on local support.

The width of the scientific topics to be presented is relatively broad and some overlap with other scientific societies that have taken over the role of EEMGS as e.g. in the Nordic countries where EUROTOX is the international organisation, with local societies, for environmental scientists.

4. EEMGS: present and future

The decreasing potential/power of the academic world for fundamental research in environmental genetics and availability to contribute to the society is a major issue.

In instances of industry sponsored research, questions of independence and bias are often raised.

In this context, it is of extreme importance to secure the scientific relevance of the results and the decisions taken by the regulators by imposing a detailed description of the conflict of interest among

researchers in publications and evaluators in the commissions.

Among the many challenges ahead of the EEMGS, let us underline some of them:

-re-evaluate some key fundamental questions which remained unsolved: do human germ cell mutagens exist [10], which combination(s) of environmentally induced genomic changes trigger and/or promote cancer [11–13], how does the interplay between epigenetics and genetics modulate cell differentiation, evolution and diseases [14,15]

- create a platform between geneticists and physicians involved in treatment of diseases with a significant genetic component, such as cancer, neurodegenerative pathologies, and others.
- develop and implement systemic biomonitoring protocols combining physiological, genetic and omics data, if possible in a single biological sample, e.g. blood, urine or saliva.
- support studies and strategies with beneficial health consequences in the problematic of global warming.
- support European colleagues and interdisciplinary research initiatives to develop an independent centre to assess the risk from exposure to mutagens.
- keep on stimulating young scientists to be creative and passionate in a research field that runs from fundamental to translational and applied questions in genetics and health.

In the future, young scientists will take over with new questions, new technologies, new discoveries and new applications. They will have to face a challenge that is not new but which takes on increasing importance: the ethical questions emerging from the impressive potential of present genetic technologies capable to impact the evolution of nature and mankind.

5. Conclusion: Advice to a young researcher

Collaboration with colleagues and other teams is of great importance to establish a stimulating open dialogue on scientific questions. The EEMGS, where academics, regulators and industries meet, plays a central role in these aspects, in particular in understanding of key mechanisms responsible of genetic and epigenetic stresses on the genome, in support of primary cancer prevention and in the establishment of internationally recognized guidelines to assess risk from mutagens and carcinogens. However, it is necessary to recommend again and again the basics: to perform careful and rigorous research, to use logic and background knowledge, to define adequate experimental designs, to provide transparency in the protocols, to check repeatability of the results and to combine several statistical approaches in order to get closer to the truth.

Declaration of Competing Interest

None.

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